

REMARKS

Claims 1, 6, 19, and 24 are amended hereby. No claims have been added.

Claims 15 and 31 are canceled without prejudice to the subject matter contained therein. Accordingly, after entry of this amendment, claims 1-14, 16-30, and 32-49 will remain pending. Claims 35-49 have been withdrawn from further consideration. As a result, claims 1-14, 16-30, and 32-34 remain under consideration.

In the Office Action dated February 16, 2005, the Examiner acknowledged to Applicant's election of claims 1-34 for further consideration. The Examiner further stated that the restriction requirement has been deemed proper and has been made final.

Claims 11, 13, 14, 17, 27, 29, 30, and 33 were rejected under 35 U.S.C. § 112, second paragraph, as indefinite for failing to particularly point out and distinctly claim the subject matter that the Applicant regards as the invention. Specifically, the Examiner stated that the use of the terms "dilution gas" and "carrier gas" was unclear, because the two gases may comprise the same gaseous material(s).

The Applicant respectfully submits that the use of these two terms is not unclear, because those skilled in the art would understand the difference between the two terms. When used, a "carrier gas" conveys the precursor to the processing chamber. (See, e.g., the specification at paragraph [0023].) A "dilution gas" is used to dilute the process gas or adjust the process gas partial pressure. (See, e.g., the specification at paragraph [0026].) The fact that the carrier gas and the dilution gas may both have the same composition (or a similar composition) would not be unclear to those skilled in the art, because the two gases are being used in different manners. Moreover, consistently with the manner in which the terms are used herein, the terms

are terms are common in the art. Accordingly, the Applicant respectfully submits that the terms, as defined by the specification and as would be understood by those skilled in the art, are not unclear. The Applicant, therefore, respectfully requests that the Examiner withdraw the rejection under 35 U.S.C. § 112, second paragraph.

Claim 31 also was rejected under 35 U.S.C. § 112, second paragraph. Specifically, the Examiner stated that the term "the showerhead" lacked antecedent basis. In view of the amendments made to claim 19, the Applicant has canceled claim 31. Accordingly, the Applicant respectfully submits that the rejection has been rendered moot.

Claim 1-14, 16-30, and 32-34 were rejected under 35 U.S.C. § 103(a) as unpatentable over Goldman et al. (U.S. Patent No. 4,619,840) in view of Wang et al. (U.S. Patent No. 6,833,161). Claims 15 and 31 were rejected under 35 U.S.C. § 103(a) as unpatentable over Goldman et al. and Wang et al., and further in view of Kalyanam (U.S. 6,491,978). The Applicant respectfully disagrees with both of these rejections and respectfully submits that claims 1-14, 16-30, and 32-34 are patentable thereover.

At paragraphs 8A and 8B of the Office Action, the Examiner stated that neither Goldman et al. nor Wang et al. teach all of the limitations of claims 15 and 31. To reject claims 15 and 31, the Examiner relied upon Kalyanam for the teaching of a showerhead. The Applicant respectfully disagrees with the characterization of these references and respectfully submits that they cannot be combined in the manner suggested by the Examiner to render the claims obvious.

Claims 1-14, 16-30, and 32-34 each recite methods including, among other features, creating a processing zone above the substrate, the processing zone being a volume defined by a diameter of the substrate and a gap between the substrate and the

showerhead and maintaining a residence time for gaseous species in the processing zone that is shorter than about 120 msec, the residence time being proportional to the volume of the processing zone and the process gas flow rate. None of the references relied upon by the Examiner disclose or suggest at least these features in combination with other features recited by the claims. Accordingly, the Applicant respectfully submits that the references cannot be combined in the manner suggested by the Examiner to render the claims obvious.

Goldman et al. describes a process and apparatus for low pressure chemical vapor deposition of a refractory metal. Goldman et al. describes a reactant gas chamber 18 with a rectangular housing 70 with a rectangular access door 72 therein. (Goldman et al. at col. 4, lines 57-60.) Within the chamber 18, a cylindrical reservoir 90 receives tungsten carbonyl powder. (Goldman et al. at col. 5, lines 11-13.) The tungsten carbonyl powder is converted to vapor when an electric current is supplied to the resistance wire 84 in the reservoir 90. (Goldman et al. at col. 5, lines 13-15.) A mass flow controller 120 meters a preset constant amount of nitrogen gas provided to the chamber 18, thereby metering the flow of tungsten carbonyl to the chamber 18. (Goldman et al. at col. 5, lines 51-57.)

In the chamber 18, the wafer 40 is heated to a temperature of between 350° and 450° C. (Goldman et al. at col. 7, lines 9-12.) The tungsten carbonyl is pyrolyzed on the wafer 40 to deposit tungsten on the wafer. (Goldman et al. at col. 7, lines 15-22.) After a run of approximately two minutes, a tungsten film of about 3,000 angstroms is deposited on the wafer. (Goldman et al. at col. 7, lines 23-27.)

Of the features recited by claims 1-14, 16-30, and 32-34, Goldman et al. does not describe several of the features recited by the claims nor does it suggest the combination of those features with other features. In particular, Goldman et al. does

not describe a showerhead. In addition, Goldman et al. does not describe creating a processing zone above the substrate, the processing zone being a volume defined by the diameter of the substrate and a gap between the substrate and the showerhead. Also, Goldman et al. does not discuss maintaining a residence time in the processing zone that is shorter than 120 msec, the residence time being proportional to the volume of the processing zone and the process gas flow rate.

Wang et al. does not cure the deficiencies noted with respect to Goldman et al. Accordingly, the Applicant respectfully submits that Wang et al. cannot be combined with Goldman et al. in the manner suggested by the Examiner to render the claims unpatentable.

Wang et al. describes cyclical deposition of tungsten nitride for a metal oxide gate electrode. Specifically, Wang et al. describes the deposition of a tungsten nitride layer having a thickness of less than 100 angstroms using a cyclic deposition technique. (Wang et al. at col. 2, lines 50-54.) During deposition, the temperature of the substrate is maintained at a temperature of between 550° and 700° C and the tungsten-containing compound is introduced preferably in a pulse of 0.2 seconds or less. (Wang et al. at col. 3, lines 18-26.) Each pulse results in the deposition of tungsten nitride in a layer of about 2.5 angstroms. (Wang et al. at col. 3, lines 34-38.)

Like Goldman et al., Wang et al. does not describe several of the features recited by the claims nor does it suggest the combination of those features with other features. In particular, Wang et al. does not describe a showerhead. In addition, Wang et al. does not describe creating a processing zone above the substrate, the processing zone being a volume defined by the diameter of the substrate and a gap between the substrate and the showerhead. Also, Wang et al. does not discuss maintaining a residence time in the processing zone that is shorter than 120 msec, the

residence time being proportional to the volume of the processing zone and the process gas flow rate.

The Applicant also respectfully points out that one skilled in the art would not think to combine Goldman et al. and Wang et al. in the manner suggested by the Examiner. Goldman et al. concerns a process that is not cyclic. Wang et al., on the other hand, is directed to a cyclic process. The operating parameters of a non-cyclic process versus a cyclic process differ from one another in several significant respects, which differences become apparent when the operating parameters of the two disclosures are compared side-by-side. Accordingly, the Applicant respectfully submits that, at least for this additional reason, the rejection by the Examiner is improper.

With respect to the third reference applied by the Examiner, the Applicant respectfully submits that Kalyanam does not assist with the rejection of the claims, because Kalyanam also fails to discuss or suggest the same features absent from Goldman et al. and Wang et al. Kalyanam describes deposition of CVD layers for copper metallization using novel metal organic chemical vapor deposition (MOCVD) precursors. As noted by the Examiner, Kalyanam does disclose an apparatus with a showerhead 440. (Kalyanam at col. 12, line 50.) However, Kalyanam is silent as to the remaining features discussed above.

Specifically, like Goldman et al. and Wang et al., Kalyanam does not describe several of the features recited by the claims nor does it suggest the combination of those features with other features. In particular, Kalyanam does not describe creating a processing zone above the substrate, the processing zone being a volume defined by the diameter of the substrate and a gap between the substrate and the showerhead. Also, Kalyanam does not discuss maintaining a residence time in the processing zone

that is shorter than 120 msec, the residence time being proportional to the volume of the processing zone and the process gas flow rate.

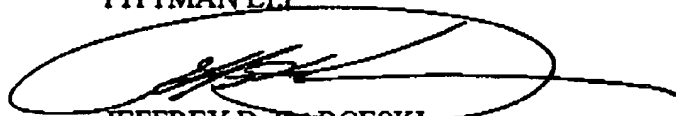
Accordingly, the Applicant respectfully submits that the references relied upon by the Examiner do not, either alone or in combination, describe or suggest the invention as recited by claims 1-14, 16-30, and 32-34. As a result, the Applicant respectfully submits that the claims are patentable over the references cited.

In view of the above amendments and remarks, Applicants respectfully submit that all of the claims are allowable and that the entire application is in condition for allowance.

Should the Examiner believe that anything further is desirable to place the application in better condition for allowance, the Examiner is respectfully requested to contact the undersigned at the telephone number listed below.

Please charge any fees associated with the submission of this paper to Deposit Account Number 033975. The Commissioner for Patents is also authorized to credit any over payments to the above-referenced Deposit Account.

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